

SeaQuest Hazard Awareness Training Handout

[PDSEAQ01/CB/01]

Version 2.3

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Overview

This document is intended to inform you of some of the more common hazards that may be encountered at the SeaQuest (E906) experiment. Please read the entire document and complete the [online quiz](#). This basic hazard awareness training is required for all personnel who intend to work at the SeaQuest Experiment. It is valid for two years. This training is mandatory for personnel who enter the SeaQuest/NM4 enclosure or who work regularly in the SeaQuest building.

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1. Introduction

This training document outlines hazards specific to the SeaQuest Experiment. The SeaQuest Experiment consists of the SeaQuest spectrometer housed in the NM4 enclosure. The goal of this training is to advise you of potential hazards and the proper precautions to take to prevent unsafe situations.

If you find a situation in which you need advice, training, review or a decision in regards to safety or safe operations, you should first go to your immediate supervisor. If you and your supervisor conclude that the matter goes beyond your own group, that you need assistance in resolving it, or that you need to arrange for safety training, you should contact the SeaQuest Spokesperson or the SeaQuest Fermilab contact. In the event of an emergency, you should call ext. 3131 from any Fermilab telephone.

Environmental Safety, Health & Quality (ESH&Q) materials referenced in this document can be consulted for guidance on ESH&Q issues. These materials can be found on-line at this URL: <http://esh.fnal.gov/xms/>

1.1. Programs for Controlling Hazards

The programs for controlling the hazards that may be found within the facilities generally have three parts: (1) reviews to minimize hazards of new systems; (2) personnel training; and (3) documented operating and safety procedures or guidelines to follow. In addition, work activities performed by Fermilab employees shall be reviewed via a Hazard Analysis (HA) before work is started (see [Fermilab Environmental, Safety and Health Manual \(FESHM\) 2060 Work Planning and Hazard Analysis](#)). Reviews to minimize hazards in the design, construction, and operation of new systems are conducted by specific review committees or Environmental, Safety, and Health (ES&H) personnel. If you are involved in an operation that you feel should be reviewed, contact your supervisor or the facility coordinator/spokesperson. Training courses are conducted by supervisors, the Particle Physics Division (PPD) Division Safety Officer (DSO), or the Fermilab ESH&Q Section, depending on the specific need. Written procedures and job hazard analyses are usually developed by those doing the work and their supervisors, in consultation with ESH&Q personnel when necessary.

2. Hazardous Energy

Many components utilize potentially dangerous high voltages and/or currents. In addition, certain electrical devices/components may retain significant electric charge after their high-voltage sources are removed. These sources of energy can cause electric shock to personnel if work on these devices is carried out improperly. All personnel are required to have [Electrical Safety Orientation \[FN000387\] Training](#), which is a brief orientation to the Fermilab Lockout/Tagout (LOTO) program and NFPA-70E for unqualified workers.

A common hazard is “daisy-chaining” of extension cords and power strips. Extension cords and power strips are designed to be used individually and not connected to others in series. Such improper installations can become a fire hazard by creating an over-current condition. Figure 1 shows examples of acceptable and unacceptable usages of extension cords and power strips. These are examples of configurations found onsite at Fermilab, however acceptable and unacceptable configurations are not limited to these examples. Contact the building manager if you have any questions.

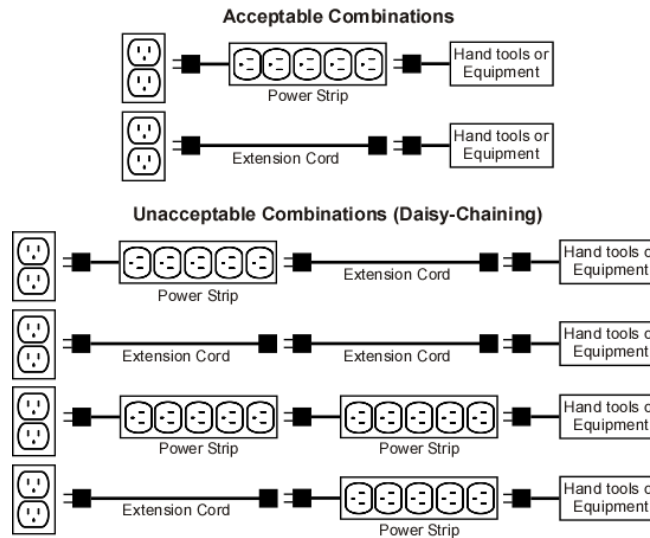


Figure 1. Examples of Acceptable and Unacceptable Combinations of Extension Cords and Power Strips.

People performing service or maintenance work on or near equipment that could cause them injury if it were to become energized must lockout and tagout that equipment's energy source(s) and must have current [Fermilab LOTO Level 2 \[FN000212\] Training](#). Only LOTO Level 2 trained personnel are authorized to work on equipment that could become hazardous to them if that equipment were unexpectedly energized. LOTO requires the use of a designated red lock and a DANGER tag to isolate the hazardous stored energy source (e.g., electricity, gravity, springs). Additional information about LOTO can be found in [FESHM 2100 Fermilab Energy Control Program \(Lockout/Tagout\)](#).

NOTE: The term "configuration control" applies to the lockout and tagging of equipment to control the state or operation of equipment or systems where individuals are not actively engaged in servicing or maintenance. The application of "configuration control" locks should be implemented with a (non-red) padlock and a CAUTION tag. Configuration control locks and/or tags are applied by persons or groups authorized by line management, and are typically removed by the same person or group who applied the devices. (See the Appendix of [FESHM Chapter 2100](#) for further details and examples of Configuration Control.)

3. Radiation Hazards

A facility may contain areas where radiation hazards can be found. Radiation fields can also be found near activated objects and radioactive sources. The ALARA (As Low As Reasonably Achievable) concept is used to keep doses to radiation workers at a minimum. Certain training and dosimetry requirements are also put in place to help keep doses ALARA. See below for specific requirements.

Everyone performing work in beamline enclosures or with radioactive material or sources is required to have [Radiological Worker – Classroom \[FN000470\]](#) and [Radiological Worker – Practical Factors \[FN000471\]](#) Training.

If work needs to be performed during a controlled access [Radiological Worker – Classroom \[FN000470\]](#), [Radiological Worker – Practical Factors \[FN000471\]](#), and [Controlled Access \[FN000311\]](#) Training is required.

If work needs to be performed with a radioactive source, [Radiological Worker – Classroom \[FN000470\]](#), [Radiological Worker – Practical Factors \[FN000471\]](#), and [Radioactive Source \[FN000048\]](#) Training is required. Only personnel who have current [Radiological Worker – Classroom \[FN000470\]](#), [Radiological Worker – Practical Factors \[FN000471\]](#), and [Radioactive Source Training \[FN000048\]](#) can sign out radioactive sources from the designated “source monitor”. These source monitors must have additional one-on-one training with the [ESH&Q Source Physicist](#). The names of the source monitors are posted on the radioactive source storage box.

Specific Radiation Hazards at the SeaQuest Facility:

This facility is posted as Controlled Area and a Radioactive Material Area.

NOTE: The roof of NM4 is posted as a Radiation Area due to potential accident dose rates on the roof. If any work needs to be done on the roof of this facility, please notify [Radiation Safety](#) prior to work.

Starting in 2015 Q1 (January – March 2015), ESH&Q started detecting neutron dose in the upstairs area of SeaQuest (NM4). The levels are low enough to not cause a Radiation Area, and therefore no health or safety concern, however this does warrant more meticulous monitoring of personnel in the area. For this reason, everyone entering the SeaQuest (NM4) facility is required to have [Radiological Worker – Classroom \[FN000470\]](#) and [Radiological Worker – Practical Factors \[FN000471\]](#) Training. Everyone is also required to wear radiation dosimetry badges throughout the entire facility, including the upstairs area and inside the enclosure, at all times. SeaQuest collaborators and anyone working in the facility for more than one (1) week must obtain a “SeaQuest” dosimeter from the [PPD RSO](#) or the [ESH&Q Dosimetry Program Manager](#) before entering the facility. This “SeaQuest” dosimeter, the 2T model, has an extra chip to more accurately monitor dose from both fast and thermal neutrons. All others who enter the facility infrequently may obtain a temporary dosimeter from the Communications Center on the Ground Floor of Wilson Hall, ext. 4251. Permanently-assigned badges for SeaQuest collaborators are located on the badge racks at the High Intensity Lab (HIL) building inside the North door. Quarterly radiation dose reports can be obtained through the PPD RSO or ESH&Q Dosimetry Program Manager. Dosimetry badges must remain on Fermilab site.

Any items removed from the beamline enclosure must be checked for radioactivity by the person(s) removing them. This person must have current [Radiological Worker – Classroom \[FN000470\]](#) and [Radiological Worker – Practical Factors \[FN000471\]](#) to remove items and perform a survey. ([GERT \[FN000241\]](#) does NOT allow you to perform a survey.) If items are found to be radioactive using the Frisker, the person(s) removing them must use the Wallflower to determine the appropriate Class level and apply the appropriate Class sticker to the item. A Frisker survey instrument is located inside the NM4 enclosure next to the roll-up door on the high-bay. A Frisker and Wallflower instrument set-up is located at the top of the north stairwell, in the entryway into the NM4 building. Radioactive items should be stored in the NM4 enclosure or in the posted cabinets near the source box when not being actively worked on.

4. Controlled Access Areas

Controlled Access is the normal mode of access during brief down-times of accelerator operation when it is expected that the beamline area interlocks will be maintained. Controlled Access is made by following the [Fermilab Controlled Access \[FN000311\] Training](#) and procedures.

5. Chemical Hazards

Small amounts of chemical materials, such as epoxies and solvents, are used or stored in certain areas. If handled incorrectly, some of these materials may become harmful. As a general practice, the use of combustibles should be limited. All hazardous (e.g., flammable, corrosive, reactive, or toxic) materials that are not in use must be stored in specially designated cabinets. Flammable liquids, such as ethanol, must be stored in a Flammable Liquids Cabinet. Figure 2 shows an example of a Flammable Cabinet. Rags or Kim Wipes used in the application or cleanup of such solvents must be collected, disposed of in flammable rag containers and must be emptied every night.

Safety Data Sheets (SDSs) containing information on all of these and other materials within the facility can be found online at http://www-esh.fnal.gov/pls/ip/msds_search.html. Additional information regarding chemical hazard communication is outlined in [FESHM 4110 Hazard Communication](#).

Contact a [Waste Generator](#) or [ESH&Q waste personnel](#) for information about proper disposal of hazardous or unknown chemicals.



Figure 2. Example of a Flammable Cabinet.

Specific Chemical Hazards at the SeaQuest Facility:

As a general practice, the use of combustibles within the SeaQuest Experiment should be limited. If there are questions regarding the combustibility of materials, contact the SeaQuest Spokesperson.

6. Environmental Hazards

An accidental release of some materials (e.g., oil, gasoline, diesel fuel) from equipment could become harmful if it is not promptly contained. Such a release can be considered harmful if it can cause adverse effects to people or the environment. If you know or suspect that such a release has occurred or will occur, call ext. 3131 to report a spill emergency. Designated personnel are trained to execute procedures designed to minimize the spread of accidentally released materials. In addition, the following materials are prohibited from disposal in trash cans and dumpsters:

- all hazardous (e.g., flammable, corrosive, reactive, toxic) materials
- degreasing agents (e.g., Freon)
- uncured epoxy
- ethylene glycol (“anti-freeze”)
- fluorescent light bulbs
- oils
- paints
- pesticides

- radioactive material, radiation signs and labels
- scrap metal
- NiCad, lead/acid, and lithium batteries
- any free liquids (regardless of chemical nature)

Contact a [Waste Generator](#) or [ESH&Q waste personnel](#) for information regarding the proper disposal of such items. Whenever possible, please recycle rather than throw away materials that are no longer of use.

7. Hazards Associated with Operating Machinery

7.1. Cranes and Forklifts

Improper use of certain equipment, such as cranes and forklifts, can endanger people working in the area as well as material being moved. People operating cranes and forklifts must complete operator training and renew this training every three years. Operators must clear personnel from the area of the lift and warn others of approaching loads. All personnel are prohibited from the area near or under any suspended load. Personnel conducting or in the vicinity of overhead lifts or lifts that have the potential to contact the head must wear hard hats and safety shoes. Procedures for crane use can be found in [FESHM 10100 Overhead Cranes and Hoists](#) and [FESHM 10140 Mobile Cranes](#).

Specific Hazards Associated with Cranes and Forklifts at the SeaQuest Facility:

Crane operators in the SeaQuest high bay warn others of approaching loads by using a bell. Crane operators must be aware of the horizontal lifeline above KMag.

7.2. Machine Shop Equipment and Power Tools

Machines in this area present hazards due to moving parts. Power tool operations present similar hazards. Training is required to work with tech shop equipment. Work with some machines requires the use of Personal Protective Equipment (PPE). Any loose clothing or jewelry that might become entangled must be removed prior to operating these machines. Hair that might become entangled should be covered or tied back. All hammering, drilling, cutting, grinding, and power tool operations require the use of protective eyewear (e.g., safety glasses or goggles) with side shields that fit snugly to the face. In addition to glasses or goggles, grinding operations also require the use of a full-face shield. Some operations may require other forms of PPE (e.g., hearing protection, gloves). Manufacturer's recommended operating instructions are a good source of information on how to operate equipment safely.

8. Hazards Associated with Working at Heights

There are unusual places throughout the facility from which people or things have the potential to fall. These include ladders, scaffolds, personnel (aerial and scissor) lifts, etc. The physical condition of ladders and scaffolds should always be inspected prior to their use and must be used in accordance with all posted instructions and/or safety precautions. Personnel lifts are available in some areas for workers trained in their use. Work from elevated platforms that have no railings requires [Fall Protection Orientation \[FN000304\] Training](#), the use of a body harness and lanyard, and a written rescue plan in the hazard analysis. Hard hats must be worn whenever someone is working above you or during overhead rigging activities.

It is common for work to be conducted at elevations above floor level. When working with ladders, a number of rules apply:

- Always use the appropriate ladder for the job. Avoid reaching or leaning from a ladder to complete a task.
- When ladders are not in use, they must be stored in a secure location that will not cause an obstruction to walkways or workspaces.
- The physical condition of ladders and scaffolds should always be inspected prior to use and must be used in accordance with any posted instructions and/or safety precautions.

Specific Hazards Associated with Working at Heights at the SeaQuest Facility:

At times personnel may need to access areas above the concrete shield pile or above the KMag magnet. When accessing these areas, you must be trained in [Fall Protection Orientation \[FN000304\] Training](#). You must be tied off and have a written Hazard Analysis when accessing these areas. Contact the PPD Division Safety Officer for access to these areas.

9. Hazards Associated with Compressed Gas and Pressure Vessels

Many facilities contain systems and operations that utilize compressed gases and pressure vessels that may become hazardous if ruptured or handled improperly. All gas cylinders must be properly regulated while used and capped while stored. They also must remain protected from falling down at all times, for example by securing them to a storage rack or other solid object. Only trained personnel, with current [Fermilab Compressed Gas Training \[FN000213\]](#), should handle compressed gasses. Additional requirements and procedures regarding compressed gas systems and pressure vessels can be found in the [FESHM 5000 series](#).

Specific Hazards Associated with Compressed Gas and Pressure Vessels at the SeaQuest Facility:

Some SeaQuest Experiment detector systems and operations utilize compressed gases and pressure vessels that may become hazardous if ruptured or handled improperly. All dewars and cylinders must be removed from the enclosure immediately after use to help reduce the chance of activation.

10. Emergencies

Call ext. 3131 in the event of an emergency situation, such as personnel requiring medical treatment for any reason. Stay on the phone until the emergency operator indicates that s/he has all of the necessary information, including your name, location and nature of the emergency. Do not attempt to bandage another person or clean any bodily fluids from another person's injury.

When evacuating any area, proceed to the designated assembly point and wait there until the 'all clear' signal is given. If you must leave and can't wait for the 'all clear', notify your supervisor or an Emergency Warden. Rescue attempts will be made by the Fire Department if someone is unaccounted-for and believed to be in an unsafe area (e.g., burning structure, oxygen deficient area). If you notice that a fellow worker is missing during an emergency, immediately report this to an Emergency Warden, the Incident Commander (Fire Dept.) or the Fire Chief.

10.1. Fire Alarm

The fire alarm is a steady alarm that may be accompanied by a flashing strobe light. It means that smoke or fire has been detected in the area.

Specific Procedures for a Fire Alarm at the SeaQuest Facility:

Leave the area via the nearest exit and go to the designated assembly point, which is in the parking lot north of the hall (near NM5).

10.2. Sitewide Emergency Warning System (SEWS)

This is a verbal communication system broadcast throughout all areas of the laboratory. It is used to notify personnel when hazardous conditions exist and what protective actions to take. It is very important that you respond to its warning tones and messages and that you follow the transmitted instructions. If the nature of the message indicates severe weather, promptly go to the designated shelter for your area.

Specific Procedures for a SEWS Message at the SeaQuest Facility:

Follow the transmitted instructions. The designated shelter areas for the SeaQuest Facility are the restrooms.

NOTE: If the experimental hall is accessible (i.e., in Open Access), the stairwells leading to the lower level may also be used as tornado shelters.

10.3. Fire Suppression System

Specific Fire Suppression System at the SeaQuest Facility:

The SeaQuest hall contains a fire suppression system that can release CO₂ underneath the false (i.e., tiled) floor in the NM4 building. The activation of this system may create an oxygen deficiency hazard (ODH) condition in these areas, especially if floor tiles have been removed. The system may only be activated manually by the fire department. It is always important to evacuate the building in the event of a fire alarm and the possibility of an ODH situation makes this even more important. The system status is indicated at the CO₂ bottle rack. If something necessitates removal of floor tiles, the Fire Technician must be notified at ext. 2924.

11. Magnetic Field Hazards

Magnetic fields may be present due to experimental operations or material handling at the facility. The primary hazard associated with static magnetic fields is difficulty handling ferromagnetic items. There is a rotational force causing objects to align with field lines. In addition, there can be a translational force that pulls objects toward the source of a magnetic field. Magnetic fields can also interact with implanted metallic or electronic devices, and there can be direct interactions with biological systems.

Specific Magnetic Field Hazards at the SeaQuest Facility:

The SeaQuest experiment employs two large dipole magnets, known as FMag (upstream, solid iron) and KMag (downstream, open air gap). Both magnets, but KMag in particular, may have large fringe fields. These fields may affect pace makers. In addition, these fields will attract loose metal (such as keys, tools, nuts, bolts, etc.) and may cause them to fly toward the magnet with great speed. As an aside, these fringe fields also have the ability to erase credit cards. Users must be aware of the conditions of the magnets, indicated by lights on the magnets themselves, before approaching the magnets. The flashing red light indicates that the magnet has power from the circuit panel, not necessarily that the magnet is turned on.

Contact the SeaQuest Control Room to verify the status of the analysis magnet. If there is any question, contact the SeaQuest Control Room to determine the magnets' status.

12. Cryogenic Hazards

There may be areas within the facility where cryogenics such as liquid nitrogen or argon may be routinely present. A leak of these materials can cause local zones of oxygen deficiency. In addition, there may be areas where acute physical hazards associated with handling cryogenic materials, such as burns to the eyes and skin, are present. When cryogenic materials are handled, appropriate PPE, such as gloves and protective eyewear with side shields, must be worn. Additional information regarding the controls and procedures required of cryogenic and ODH areas are contained in [FESHM 5032 Cryogenic System Review](#) and [FESHM 4240 Oxygen Deficiency Hazards \(ODH\) \(Work Smart Standard\)](#).

13. Confined Spaces and Limited Access Areas

Confined spaces are locations in which hazards, such as poor illumination, difficult emergency escape and ODH, can be intensified. A written permit and [Fermilab Confined-Spaces \[FN000003\] Training](#) is required for access to any confined space. Additional policies and procedures regarding access to confined spaces can be found [FESHM 4230 Confined Spaces](#).

Specific Confined Spaces and Limited Access Areas at the SeaQuest Facility:

The sump pump pits in the NM4 enclosure are confined spaces. Do not enter unless you have a completed entry permit. Contact [ESH&Q Confined Space personnel](#) for entry permit approval.

14. Miscellaneous

The following describes some additional general hazards and work rules which exist within the facilities:

- Smoking at facilities is permitted only outdoors and at least 15 ft. from the nearest indoor entrance.
- All new visitors working at Fermilab must register with the Users' Office (Wilson Hall Mezzanine, ext. 3111) upon their arrival.
- It is always preferred that people not work alone. When this is impractical, workers should at least insure that another person, such as their supervisor, is aware of when and where they are working, and they should make arrangements to periodically check-in with that person. This is especially important for work during off-hours. Also note that for some types of jobs, explicit "two-man rule" requirements may exist.
- **Nothing** must be attached to or suspended from overhead sprinkler pipes.
- Since janitorial personnel do not service some areas within the facilities, you must clean up after yourself.
- Appropriate PPE must be worn to protect against hazards.
 - At the SeaQuest Facility, closed toe shoes are required in the experimental hall at all times.
- No food or drink is allowed in the experimental hall.